CONODONT RELATIVE ABUNDANCE
IN A SECTION OF MIDDLE UPPER ORDOVICIAN ROCKS
FROM NORTHERN KENTUCKY.

Presented in Partial Fulfillment of
the Requirements for the Degree of Bachelor
of Science.

By

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TABLE OF CONTENTS

ILLUSTRATIONS

TABLE

INTRODUCTION

This report presents the relative abundance of the conodont fauna contained in the exposed Upper Ordovician rocks from a roadcut in northern Kentucky. The study is a contribution to the regional correlation and re-evaluation of the reference standard of the Ordovician Series begun in 1957 by Professor Walter Sweet of the Ohio State University.

Investigations of the conodont biostratigraphy in the Cincinnati region have been active over the past 25 years. The descriptions and interpretations of these sections have been tabulated in the form of conodont relative abundance logs(Sweet,Bergström,and Rust, 1965). Stratigraphic correlations between the sections are then inferred based on changes in the depositional environments of an area, as shown by the fluctuation of the relative amounts of representative elements in these logs.

The conodont elements obtained and described in this report were collected from a section of Middle-Upper Ordovician rocks exposed in northern Kentucky along Reidlin-Mason Road, 0.2 miles from the intersection of Ky. State Route 16 and Taylor Mill Road in Forest Hills, Kentucky. The rocks exposed include the uppermost 28 feet of the Kope Formation (Edenian), all 105 feet of the Fairview

Formation, and approximately 17 feet of the lowermost Grant Lake Limestone (Bellvue Member). The conodont biostratigraphy of the top of the Kope Formation, all of the Fairview Formation, and the base of the Grant Lake Limestone (Bellvue) is described in this paper.

Many studies have been completed on the conodont fauna of the Cincinnatian Series. James (1884) described the element Prioniodus dychei, (which later became a Trichonodella element and is now a form species of the multielement Plectodina). Later works such as Sweet, Turco, Warner, and Wilkie, (1959); Pulse and Sweet (1960); Sweet, Bergström, and Rust, (1965); Bergström and Sweet, (1966); Kohut and Sweet, (1968); Seddon, George, and Sweet, (1971); Sweet and Schonlaub, (1975); and Sweet (1979) have carefully studied and described the conodonts of the Cincinnati Region. Therefore, this paper does not attempt to recapitulate the results of the previous workers. It does, however, synthesize the results of the past with the findings of the present.

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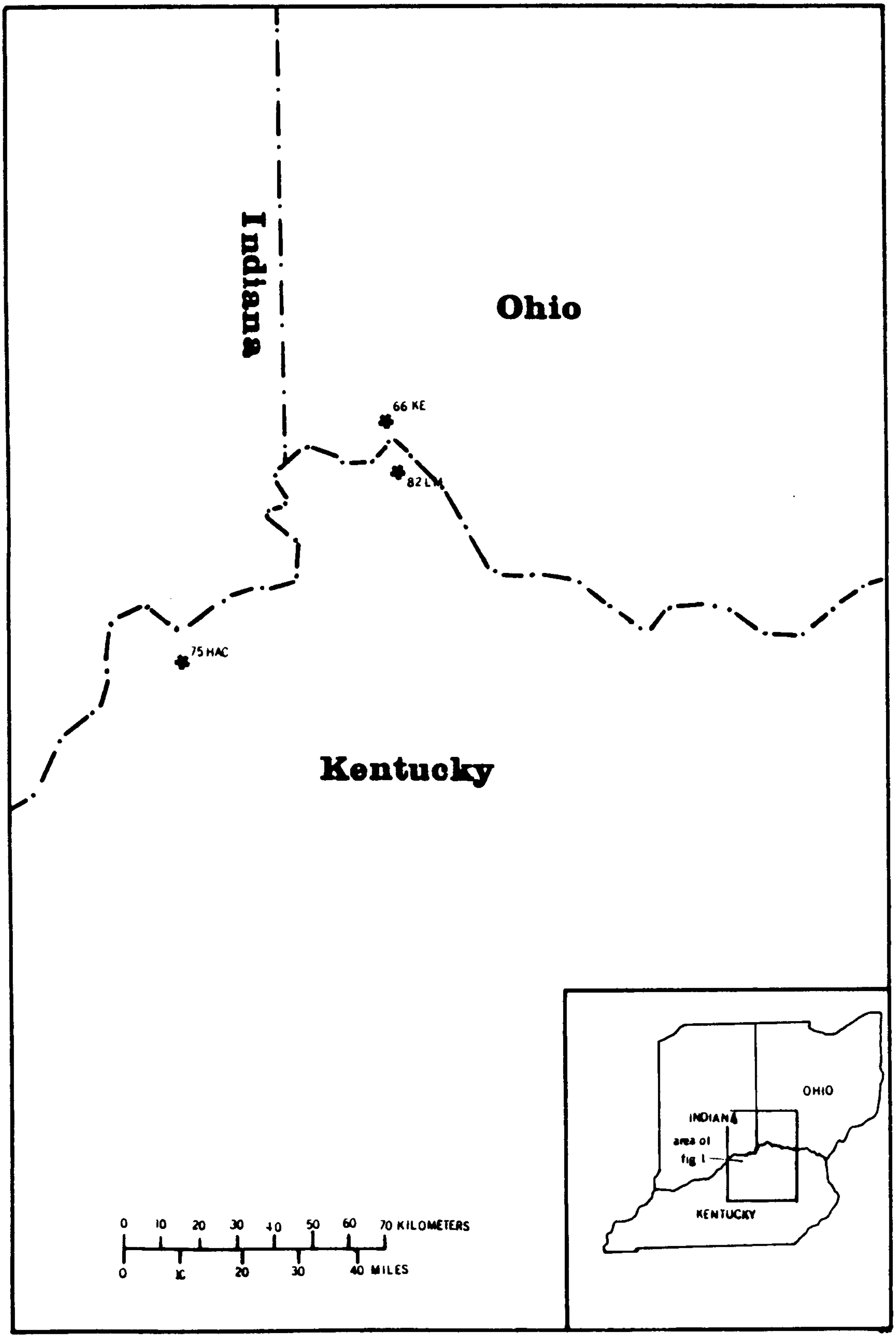

Figure 1.- Index map of the Cincinnati Region showing the location of referenced sections.

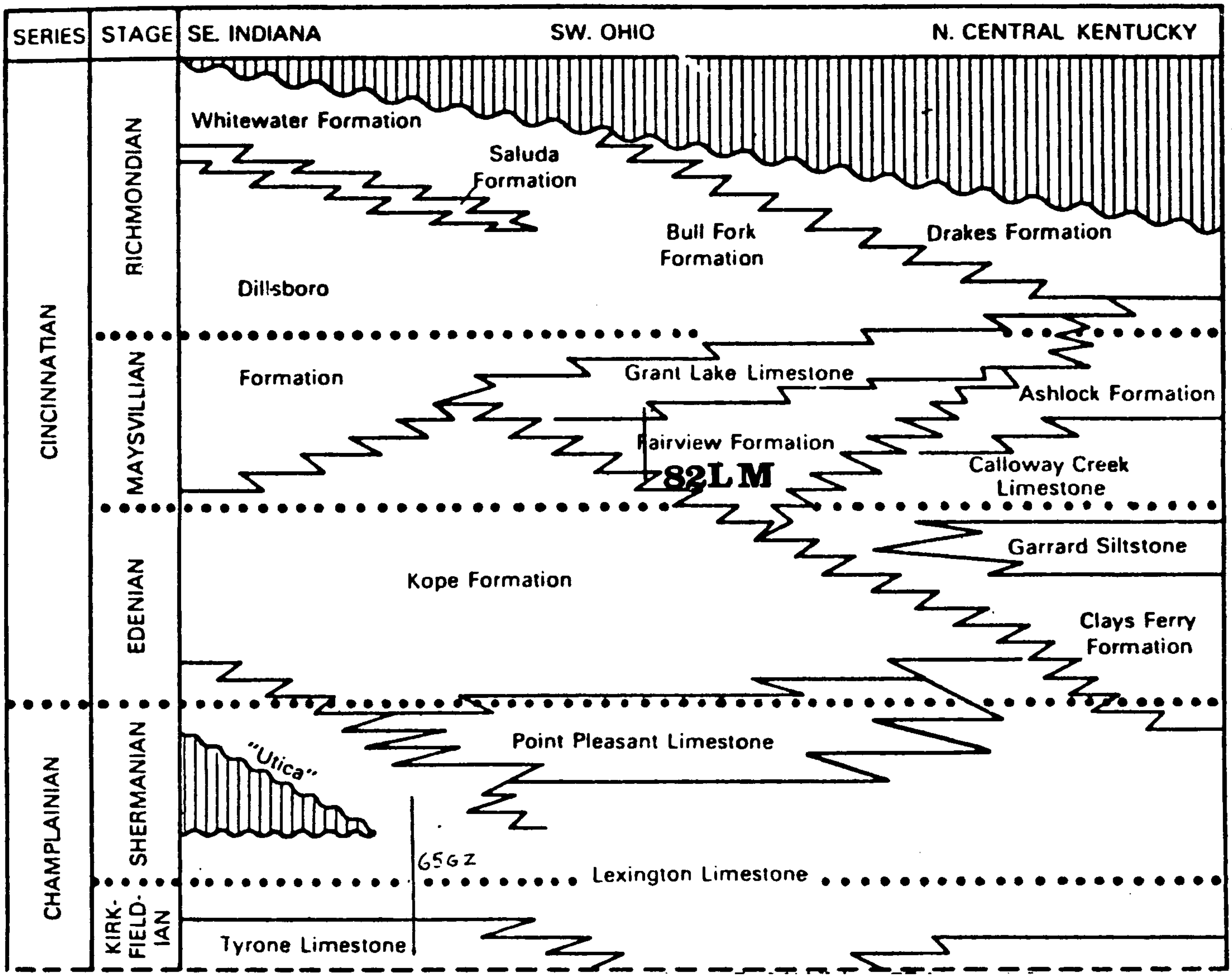

Figure 2.- Stratigraphic relationship of 82LM to Middle and Upper Ordovician rocks in the Cincinnati Region. Position is indicated by uppermost vertical bar. (Modified from Sweet, 1979)

METHODS AND PROCEDURES

Samples from the section designated 82LM were collected in intervals approximating two meters (6.5 ft.) with the first sample collected at an elevation of three meters above the base of the outcrop. This sample was taken from the most resistant limestone bed that section of the exposed portion of the upper Kope Formation. Sampling continued through the Kope, the Fairview Formation except where the formation was covered at the 18.0 meter (59 ft.) mark above the floor of the outcrop. Approximately 2.25 meters (7.4ft.) of the Fairview Formation was covered at this point. Samples were taken throughout the rest of the Fairview and at two locations in the Grant Lake Limestone. In all, nineteen samples were gathered with a mean sample interval of 2.37 meters (7.78 ft.) and a standard deviation of $\pm$1.296 meters (4.25 ft.).

500g of each sample were processed in the lab using glacial acetic acid on the crushed samples. The samples were placed in a perforated plastic bucket which was then suspended in a larger plastic bucket. A solution of 5:1 water-acetic acid was used to dissolve the calcium carbonate matrix of the rocks. Most of the samples were reduced completely after five days. Those samples with a greater percentage of shale to limestone took considerably longer to dissolve.

The samples were then drained of the calcium acetate solution, washed thoroughly, seived through a 140 mesh screen filtered, dried quickly to prevent caking, and stored.

The individual residues were examined for conodont elements by sprinkling a small quantity of the residue over the surface of a ruled examination tray. The elements were then picked from the tray and deposited onto a micropaleontological slide. After all elements were removed and the residues re-examined, the conodonts were grouped according to morphology. Once the similar forms were separated and noted the relative-abundance of the representative conodont elements could be determined.

The majority of specimens recovered from the samples represented three species: *Phragmodus undatus*, *Plectodina tenuis*, and *Oulodus velicuspis*. The relative-abundance of these three species compared to the abundance of the three minor species recovered from the samples suggests that the results were not influenced by failure to pick all of the elements from the samples. This is due to the fact that in none of the samples was the number of minor species elements greater than the number of major species elements. Outside factors may have influenced the derived relative-abundance log for 82LM. The possibility of destroying representative elements in the washing process is slim. An influencing factor may have been the electromagnetic separator. The machine could have destroyed a percentage of representative elements during separation. However, since the derived relative-abundance log for section 82LM (fig. 3) appears to match the master log sections (fig. 4) there is little reason to consider these possible outside sources of bias.

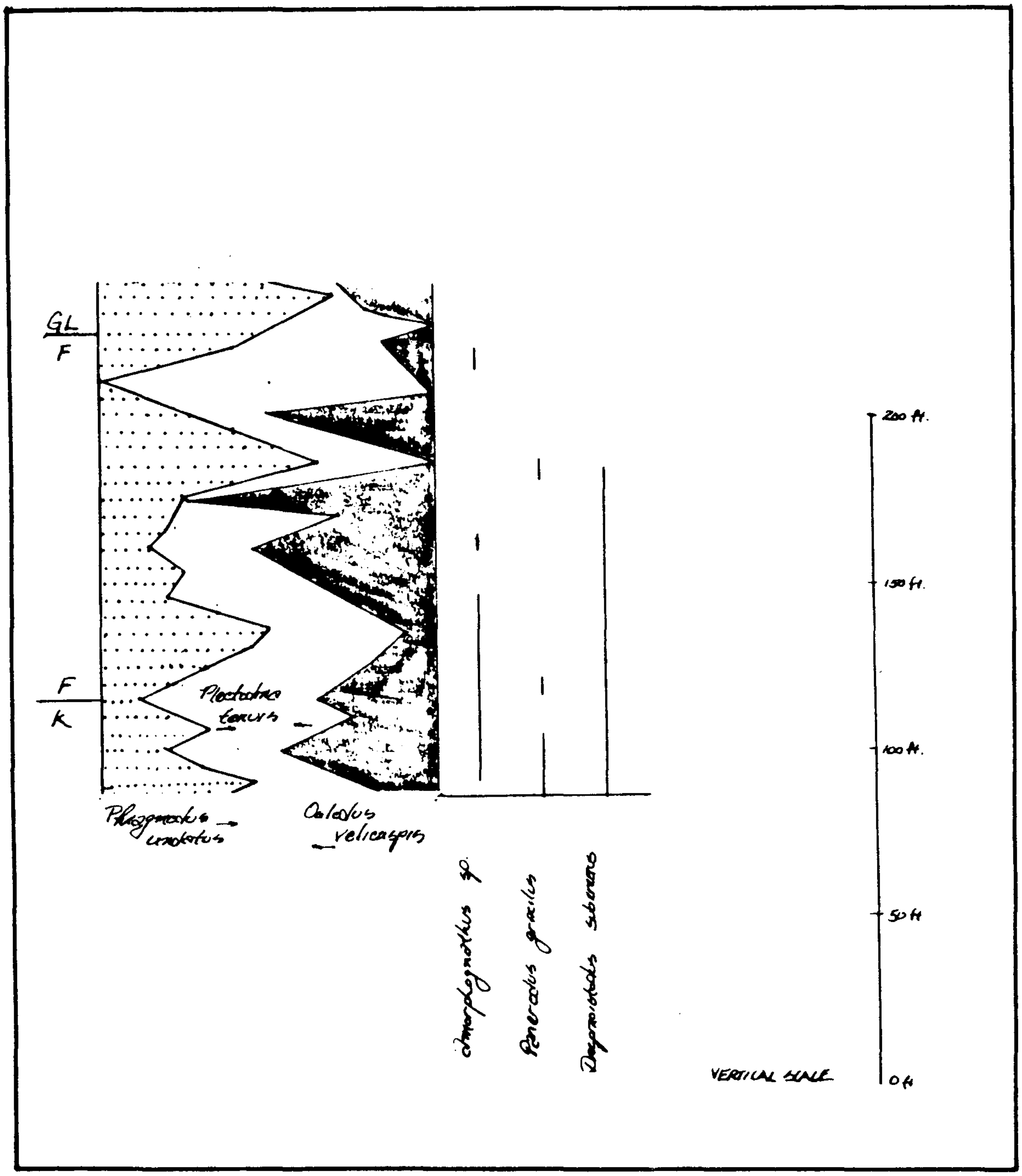

Figure 3.- Relative-abundance log and stratigraphic ranges of conodont species within 82LM.

RELATIVE ABUNDANCE

In order to interpret the results from the study of section 82LM one must have an understanding of the development of conodont biostratigraphy in the Cincinnati Region and how previous studies serve as a foundation for the results presented in this paper.

From the work of Sweet and others, in 1959, it was concluded that conodonts from Edenian rocks (Kope Formation) (see fig. 2) of the Cincinnati Region contain elements from two different Provinces: a "North Atlantic Province" and a "North American Midcontinent Province." The "North Atlantic Province" is equivelent to the "Anglo-Scandanavian-Appalachian Province" stated in Sweet (1979). Pulse and Sweet (1960) determined that several species from the North Atlantic Province were found in Maysvillian (Fairview Formation) conodont faunas. Pulse and Sweet also found that Richmondian rocks (see fig. 2) contained conodonts which were not related to either the North Atlantic Province nor the North American Midcontinent Province elements of the Edenian and Maysvillian faunas (Sweet, 1979).

The "North American Midcontinent Province" was further subdivided into two sub-provinces: "interior" and "exterior" (Sweet, 1979). In general, the exterior subprovince is determined by the genera *Phragmodus* and *Plectodina* while the interior subprovince is dominated by *Panarodous* and *Belodina* (Bergström and Sweet, 1965). It was also recognized that the exterior subprovince of the Cincinnati Region was again divided into northern and southern elements (Kohut and Sweet, 1968). Phragmodus and Plectodina, the dominant species of the North American Midcontinent exterior subprovince, are termed "northern fauna." They are characteristic of deeper depositional sites. The "southern fauna" of the interior subprovince is dominated by Aphelognathus, Oulodus, and Rhipidognathus. The southern faunal assemblages have been found to be indicative of deposition in very shallow water. The depth of deposition was determined by conodont faunal assemblages and lithologic characteristics (Kohut and Sweet, 1968; Sweet, 1979).

The conodont assemblages of Middle and Upper Ordovician rocks of the Cincinnati Region do not present themselves as stratigraphic markers because of their wide lateral and vertical extent. Sweet, Bergström, and Rust, (1965) proposed the use of relative-abundance analysis of abundantly represented species for the establishment of conodont biostratigraphic correlation. By plotting the fluctuations of the deeper-water genera (Phragmodus and Plectodina) and the fluctuations of the shallow-water genera (Oulodus, Aphelognathus, and Rhipidognathus) one would be able to plot a graph that could be correlated to similar graphs in the area, provided that these fluctuations and environmental changes were basin wide.

Before interpreting the logs presented in figs. 3 and 4 one should remember these relationships of the conodonts in the Cincinnatian Region:

Abundant Phragmodus and Plectodina:

North American Midcontinent Province
exterior subprovince- deep water indicator

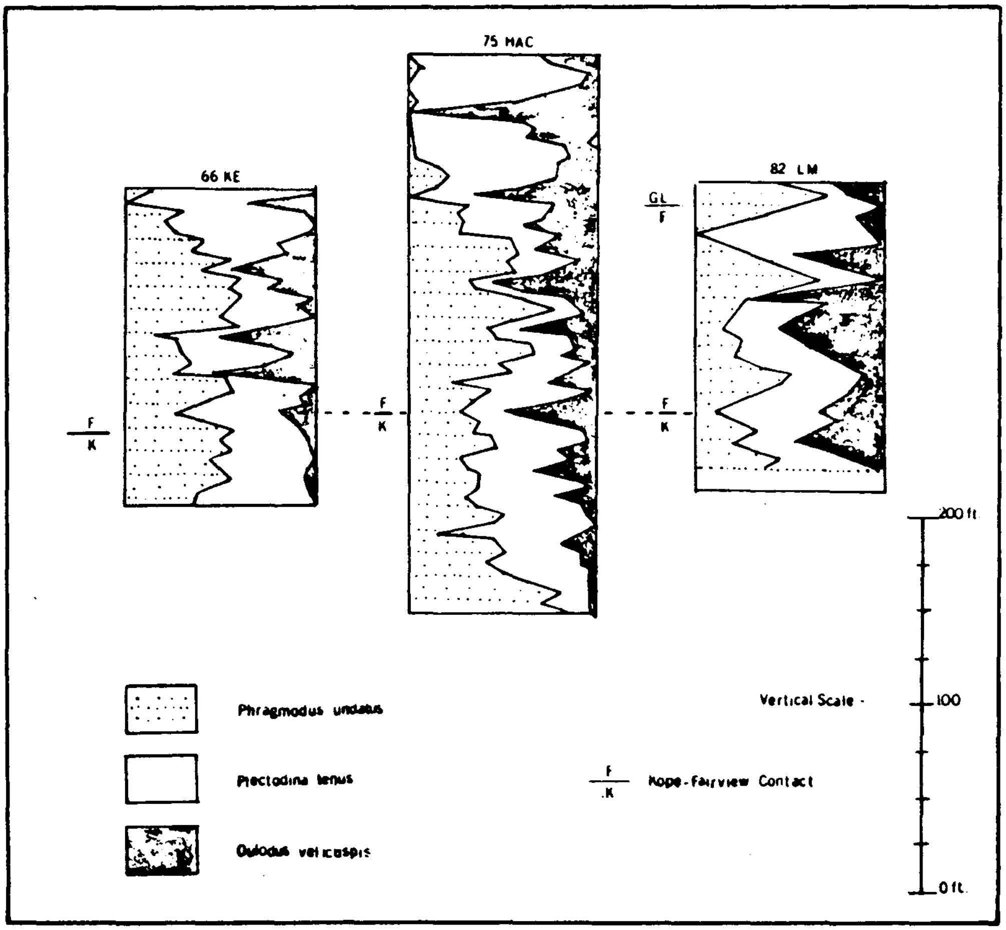

Figure 4.- Correlation of 82LM with 66KE and 75HAC based on relative abundance of conodont elements.

Abundant *Oulodus*
North American Midcontinent Province
exterior sub-province
shallow water indicator

INTERPRETATIONS AND CORRELATIONS

The relative history of water-depth fluctuation for the points which have been sampled and controlled can be attained by visual inspection of the relative-abundance log for 82LM (Fig. 3). There is a seemingly identical fluctuation in water depth as indicated by the pattern association of the peaks of *Oulodus velicuspis* and *Phragmodus undatus*. The two graphs appear as if they could fit together as pieces from a puzzle. These peaks are the water-depth pulses.

Figure 4 shows 82LM correlated with two other sections taken from the master log. The geographic location of the sections is shown in figure 1. The relative position of section 75HAC is reversed to how it appears with 66KE on the master log. The dashed lines between the logs represent theoretical correlations of basin-wide changes in the environment of deposition. These two sections correlated best with 82LM than did the others plotted on the master log.

The resolution of 82LM is quieter than the graph of 66KE, the type section of the Fairview Formation, and 75HAC. This lack of ground noise is due to sampling methods used. Only 19 samples were collected and the interval between the samples was not constant. Therefore the log appears smoother because fewer points of relative activity have been controlled.

Only one correlation line has been drawn between the graphs due to the fact that the samples taken from the upper third of the section contained very few conodont elements (Table 1). A correlation based on a relative-abundance of a small number of elements exaggerate the significance of the fluctuation.

CONCLUSION

The results of the relative-abundance of the conodonts recovered from 82LM appear to correlate well to the previous correlations from the analysis of other sections in the Cincinnati Region. The dominant species from this section was *Phragmodus undatus*. This could signify that the depositional environment monitered by the samples taken from 82LM was one that was well suited for the growth and development of *Phragmodus undatus* in deeper waters.

Table 1: Tabulation Results of 82LM

Sample Number	*Phragmodus undatus*	*Plectodina tenuis*	*Oulodus velicuspis*	A	P	D
82LM- 9.8	32	38	7	X	X	X
82LM-11.5	13	19	8	X	X	X
82LM-16.4	5	6	8	X		X
82LM-27.9	8	9	5	X		X
82LM-29.5	2	11	7	X	X	X
82LM-40.3	49	53	24	X		X
82LM-43.3	7	6	3			X
82LM-52.5	26	47	8	X		X
82LM-59.0	3	0	12			X
82LM-68.9	4	6	6			X
82LM-74.5	2	4	7			X
82LM-83.9	2	6	4			X
82LM-95.7	2	1	5			X
82LM-104.0	66	36	4		X	X
82LM-112.1	16	4	21			
82LM-128.5	0	3	0	X		
82LM-131.2	54	48	18			X
82LM-138.7	3	1	0			
82LM-150.2	4	1	2			

A= *Amorphognathus* sp.

P= *Panderodus gracilis*

D= *Drepanoistodus suberectus*

19 Samples, 827 Conodont Elements

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